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PATENT SPECIFICATION (11) 1 505 511

(21) Application No. 20737/75 (22) Filed 15 May 1975
(31) Convention Application No. 7417178
(32) Filed 17 May 1974
(31) Convention Application No. 7513769
(32) Filed 2 May 1975 in
(33) France (FR)
(44) Complete Specification published 30 March 1978
(51) INT CL² B63B 43/14 B60C 3/00
(52) Index at acceptance
B7A BA GT

(19)

(54) AN INFLATABLE DEVICE FOR USE WITH A BODY INTENDED TO FLOAT

(71) We, ETAT FRANCAIS, represented by THE MINISTERIAL DELEGATE FOR ARMAMENTS, of 14 Rue Saint-Dominique, 75996 Paris Armees, France, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to an inflatable device in or for a body intended to float, the device being inflatable in order to provide, or increase, the buoyancy of the body when the device is provided therein.

The invention is particularly, though not exclusively, concerned with an inflatable device for use in bodies of the type used in the transport of loads by water, such as ships and especially amphibious vehicles. However, the inflatable device according to the invention has general application in providing, or increasing, the buoyancy of the body intended to float, including ships, amphibious vehicles, ferry boats, floating bridges, pontoons and the like, and the expression hereinafter employed "a body of the type specified" is to be understood as including the above examples and any other body intended to float, whether by its own buoyancy, or by the buoyancy provided by the inflatable device of the invention when provided therein.

As mentioned above, the inflatable device according to the invention is especially (though not exclusively) suitable for use with an amphibious vehicle.

In fact, these amphibious vehicles, must, on the one hand, have maximum buoyancy on the water since, in their most general form of utilisation, they serve for transporting extremely heavy loads and, on the other hand, they must have minimum bulk on land for obvious reasons connected with manoeuvrability and bulk.

A known solution whereby it is attempted to conciliate these two characteristics consists in disposing in recesses formed in the lateral walls of the hull of the floating device pneumatically inflatable envelopes which remain permanently in position in the said recesses. It suffices then to inflate them in order to make them utilisable. However, this solution has some disadvantages consisting, primarily, in that securing of the pneumatic envelope on the walls and the support the task of which it is to transmit the Archimedes thrust to the device is difficult in view of the various shapes and positions adopted by the float in the inflated condition and in the deflated condition. This securing is also made difficult due to the fact that the pneumatic envelope must, of course, remain fluid-tight; but the securing means are subjected to considerable forces when pressure is exerted on the envelope walls. Secondly, although inflation of the float is relatively simple if a machine for supplying compressed air is utilised, deflation and positioning of the float in the deflated and folded state with the minimum of manual intervention has as yet found no known solution. This second point is considerably important, in order to prevent deterioration of the material constituting the pneumatic envelope.

According to the invention there is provided an inflatable device in or for a body of the type specified, said body having a wall adjacent which the device is locatable, and said device comprising:

an inflatable and deflatable float positionable adjacent said wall;

a flap pivotally mountable relative to said wall for movement between open and closed positions relative to the wall, and co-operable with said float, said flap when in the closed position serving to maintain the float against the wall when the float is deflated;

means for inflating and deflating said float;

and means for pivoting the flap between the open and closed positions independently of movement of the flap consequent upon inflation and deflation of the float;

in which the float is defined at least partly by at least one member made of flexible material, and securable to said wall and to said flap by securing means locatable in the vicinity of the edges of the wall and of the flap.

Preferably said means for securing the flexible member are constituted by flexible tongues secured at one of their edges with the flexible member and at the other of their edges with the wall, conveniently the outer wall of a hull of the body or a face of the flap. The flexible tongues may be sewn and adhesively secured on the said flexible member or fixed on the said member by means of screws and nuts, fluid-tightness being maintained with the aid of sealing rings or washers.

The float may be constituted on the one hand by rigid surfaces partially constituting the face of the flap and of the outer wall and, on the other hand, by at least one flexible articulation member and at least one flexible end piece manufactured from a fluid-tight flexible fabric and secured over their entire periphery in fluid-tight manner on the said rigid surfaces.

Preferably, the means for inflating and deflating are a single device (one and the same device) comprising at least one air compressor associated with a circuit comprising two valves of the three-way type, a piloted valve and a respiration valve permitting, furthermore, maintaining the float in the inflated or deflated state despite a possible slight degree of lack of fluid-tightness.

The said first means permitting displacement of the flap may be, preferably, either at least one linear jack or at least one rotary jack. What is involved may also be simply the pressure and depression exerted on the flap through intermediary of the float.

Manipulating means for pivoting the flap about its pivoting axis may comprise at least one linear jack for controlling the pivoting of the flap such that the rotation couple (or torque) transmitted to the flap is substantially constant. The manipulations for opening and closing the flap are in fact hindered by the thrust due to the float itself and tend to bring about opening of the float, notably when the float is almost totally inflated.

Preferably improved means are provided for manipulating the flap having an increased degree of robustness and reliability, and they permit more rapid manipulation of the flap.

Thus, said means for manipulating the flap may comprise:

at least one linear jack fast with the hull and disposed in proximity of the lateral external wall of the latter,

a lever pivoting about a pivot substantially parallel thereto and formed with an oblong, curvilinear port the equidistant walls of which are arcs of a circle having a common centre,

means driving the flap in rotation and exhibiting a pivot substantially parallel to the said wall, being displaced in the said port and being fast with the flap in the vicinity of the axis of rotation of the flap relative to the wall.

According to a further preferred feature, the device is characterised furthermore in that the distance between the rotation axis or rotation pivot of the flap and the pivoting axis or pivot of the lever is smaller than the sum of the distances between on the one hand the rotation axis of the flap and the axis of the means driving the flap in rotation and, on the other hand, the pivoting axis of the lever and the common centre of the arcs of a circle constituting the equidistant walls of the port.

It is further preferred that the difference squared between on the one hand the distance separating the axis of rotation of the flap and the pivoting axis of the lever and on the other hand the distance separating the pivoting axis of the lever and the common centre of the arcs of a circle constituting the equidistant walls of the port, increased by the square of the distance separating the said common centre and the pivot of the means driving the flap in rotation is substantially equal to the square of the distance between the axis of rotation of the flap and the pivot of the means driving the latter in rotation.

The invention will now be described in more detail, by way of example only, with reference to the accompanying drawings in which:—

Figure 1 is a diagrammatic illustration of a body of the type specified in the form of an amphibious vehicle, equipped with an inflatable device according to the invention;

Figure 2 is a view in cross-section through the vehicle of Figure 1;

Figures 3, 4, 5, 6 and 17 show a cross-section through the device, in the open position;

Figures 7, 8, 9 and 10 show a cross-section through the device, in the closed position;

Figures 11 to 16 show a cross-section in respect of various modes of means for

securing a float on the flap of the device and to the hull;

Figure 18 is a diagrammatic view of the inflation and deflation circuit for the device;

Figure 19 is a longitudinal section through a pilot valve of the inflation circuit; and

Figures 20 and 21 show, diagrammatically and in section, means for manipulating the flap, corresponding respectively to the open and closed positions of the flap.

Figures 1 and 2 show an amphibious vehicle equipped with the device according to the invention. It comprises a hull 1 displaced on land by four wheels 2 which are in the "land utilisation" position in Figure 1 and in the "aquatic utilisation" position in Figure 2, and which is displaced on the water by a screw 3. Fitted on each lateral side of the craft is a device according to the invention, shown with the flap 6 in the closed position in Figure 1 and in Figure 2 (left-hand portion) and in the open position in Figure 2 (right-hand portion) with the float or envelope 5 unfolded in the position for utilisation on the water.

Figure 3 shows the device according to the invention in the utilisation position. The flap 6 is in the open position, the angle included with the outer wall of the hull being substantially equal to 90°. The flap 6 is actuated by a linear jack 7 the length variation of which is transmitted to a link 8 articulated to a pivot 9 associated with the hull 1 of the craft. The link 8 acts on the flap 6 which rotates about its hinge pin 10.

Referring to Figures 20 and 21, the end 43 of the rod of the linear jack 7 has a ring or annulus into which is introduced a projection on the end 44 of the lever or link 8. The said lever is driven in rotation about the pivot C by the jack lodged in the hull in the vicinity of the outer wall 4 thereof. The pivot C may take the form of a metal rod fast with the hull, substantially parallel to the wall 4 and preferably located in the vicinity of the latter. The other end 45 of the lever 8 is formed with an oblong, curvilinear port 46 the equidistant walls and the pivot or axis of which are parallel arcs of a circle having a common centre D. The flap 6 is articulated for rotation about the cylindrical pivot 10, represented geometrically by its centre A, fast with the hull in the outer wall thereof. The flap 6 is provided with a pivot 47, which here is cylindrical and is represented geometrically by its centre B, parallel to the pivot 10, the distance thereof relative to the pivot 10 setting up a lever arm, and which takes up a position in the port 46 to drive in rotation the flap on pivoting the lever 8. Preferably, the said means driving the flap in rotation is a runner (or skid, shoe) oscillating about the pivot the centre whereof is B.

Since the positions of the points A and C are arbitrarily fixed and the length of the lever arm AB is given, the construction and position of the points B and D are deduced from the following relationships connecting the lengths of the segments:

$$AC<AB+CD$$

and

$$(AC-CD)^2+DB^2\simeq AB^2$$

Manipulation of a flap extending along almost the entire length of the lateral wall of the hull, and thus having relatively considerable weight, is of course facilitated by disposing along the said wall a plurality of devices as described hereinabove.

Figure 4 shows a device according to the invention in the utilisation position. In the case of this embodiment, it is fitted with a rotary jack 11 the rotation axis of which is identical with the pivot of the hinge means 10.

The angle included by the flap 6 and the outer wall 4 of the hull may be smaller than 90° or, as shown in Figure 5, greater than 90°.

Figure 6 illustrates the case wherein the flap pivots whilst on the one hand descending in order to pass from the closed position to the open position and on the other hand, whilst ascending in order to pass from the open position to the closed position. In this case, of course, the flap proper contacts the water.

Figures 7, 8, 9 and 10 show the device according to the invention in the closed position and equipped with a linear jack 7 (Figure 7) or a rotary jack 11 (Figures 8, 9 and 10). The section shown in Figure 9 illustrates the particular configuration of the flap 6 which possesses at its sides which are not connected to the outer wall of the hull an edge or flange 6a permitting isolation or insulation of the pneumatic envelope from the external atmosphere. The advantages of such a configuration will be clearly perceived; it permits protecting the material constituting the pneumatic envelope against any external mechanical or atmospheric attack during land utilisation of the craft or contrivance designed and, consequently, achieving longer service life of the device according to the invention. The same advantages are obtained with the embodiment shown in Figure 10, wherein the envelope is imprisoned, in the closed position, in a recess formed in the hull 1 of the contrivance, the flap 6 constituting the lid or cover of the said recess.

When the flap is in the closed position,

the pneumatic envelope 5 is deflated and is gripped between the outer wall 4 of the hull 1 and the flap 6 (Figures 7, 8, 9 and 10). The envelope 5 occupies this space correctly and without creases. This is due to the fact that the length of the free portion of the envelope in the inflated state is substantially equal to the length of the portions of the envelope contacting the flap and the wall; the expansion of the flexible materials conventionally employed for producing the said envelope 5 being negligible under the inflation pressure effect. This is illustrated in Figure 4 by means of the inequality of the lengths *a* and *b*. The fact that the pneumatic envelope is, in the deflated state, correctly folded and without creases also promotes lengthening of its service life by preventing random folding which would result in fissures.

As stated previously, the float may be constituted by the rigid surfaces of the inner face of the flap and the outer wall or by at least two articulation and end members made from fluid-tight flexible fabric secured in fluid-tight manner on the said rigid surfaces, or by a flexible, fluid-tight envelope secured to the hull and to the flap.

The main envelope securing points in this second eventuality are illustrated in Figure 4. Two securing categories are distinguished: these are the articulation securing means and the end securing means; the articulation securing means (points 13 and 14) are located at the side of the hinge of the flap 6 on the hull 1 and they serve simply for preventing the envelope 5 from being dislodged from this corner and resulting in the formation of creases during deflating and folding; the end securing means (points 15 and 16) are located at the end of the flap 6 and at the inner end of the wall 4 and they serve for the fixing proper of the pneumatic envelope.

It is the latter means which are subjected to the largest forces.

Figure 11 illustrates an example of embodiment in respect of articulation securing. The envelope 5 is interrupted to fit thereto in fluid-tight manner a flexible tongue 17 into which extends a shackle (or connecting link) 12. The said shackle is not able to escape from the tongue 17, for example by tearing it, since it is retained by a rope or a bolt-rope 18 fast at 17. The shackle 12 is secured to the hull 1 by a pivot 19 about which it is able to rotate. Thus, the assembly 17, 12 and 19 constitutes a flexible but robust securing means permitting all the positions of the envelope between the folded and deflated position and the open and inflated position.

Figure 16 shows a second mode of embodiment in respect of articulation securing means. It is constituted by a flexible tongue 43 fitted on the envelope and terminating in a bead 44 designed for example as in the case of Figure 11. The said bead is slid into a groove in a rigid longitudinal member 45 extending parallel to the hull and to the flap. The groove has a narrow entrance which permits longitudinal movement of the tongue 43 but prevents transverse movement of the bead 44. The introduction of the bead into the groove is effected at one of the ends of the member 45 which is subsequently blocked. The member 45 is secured to the hull and to the flap by any appropriate means (welding, screwing, etc.). Such articulation securing may also be employed as end securing means.

Figure 12 shows an embodiment in respect of the end securing arrangement. A flexible tongue 20, constituting an integral portion of the envelope 5, imprisons a bolt-rope 21, thereby producing an increase in thickness; the latter is made use of in order to prevent sliding of the tongue under a profile or section member 22 which compresses it on the flap 6 or on the outer wall 4 of the hull by means of studs and nuts 23 or by any other means.

Figure 13 shows a further embodiment for end securing. A rigid tongue 24 is secured on the envelope 5 by screws and nuts gripping the envelope 5 between tongue 24 and a counter-plate 46.

The securing arrangement is made deformable by means of articulation means 25 connecting the tongue 24 to a rigid plate 26 secured on the flap 6 or the outer wall 4 by any appropriate means.

Figure 14 illustrates a further embodiment of end securing means. A flexible tongue 27 attached on the envelope 5, for example by sewing and sticking, encloses a cylindrical tube 28 serving for securing and as rotation pivot for a flexible connecting cloth fabric 29 closed on itself by sewing and sticking for example. The said fabric 29 is connected by a chain link to a shackle (or link) 30 secured to a pivot associated with the hull or the flap of the craft, as previously described with reference to Figure 11.

Figure 15 illustrates a supplementary mode of embodiment of an end securing arrangement. A flexible tongue 31 is secured in fluid-tight manner by screws and nuts on the envelope 5; it engages a bolt-rope 32 which prevents it from sliding when it is compressed between the hull or the flap by a rigid section member 33 maintained by any appropriate means, for example as shown in the figure by studs and nuts 34.

The Figure 17 illustrates the case wherein the float is constituted on the one hand by a rigid and fluid-tight portion of the surface

of the inner face of the flap 6 and of the outer hull 4 of the craft and on the other hand by two pieces of flexible fabric 5a and 5b, called respectively the articulation member and the end member, each connected to the flap and the hull over their entire periphery and in fluid-tight manner. Such fluid-tight connection may be achieved for example in a manner similar to that described with reference to Figure 15, i.e. by compressing against the hull or the flap the end of the fabric, enclosing a bolt-rope 32, by a profile member 33 maintained by any appropriate means, the bolt-rope serving as previously stated for preventing the fabric from sliding out of its position.

The flexible materials which can be utilised in the various modes of embodiment of the device according to the invention are well known in this technical field. They are, in a general manner, so-called coating fabrics, i.e. fabrics made from synthetic polyamide coated with an elastomer.

Figure 18 shows an embodiment of the circuit for inflating and deflating the envelope 5 employing means for generating overpressure or for compressing low pressure air 37.

During inflation operation, the fresh air is aspired from the atmosphere through the three-way valve 38 which is then oriented as shown in the drawings. The air is put under pressure by the overpressure generating means or compressor 37 and is fed through the three-way valve 39 which is oriented as in the drawings, to the piloted valve 40 which is open either under the air pressure or under some other remote-controlled action thereby allowing the air to enter the envelope 5. The respiration valve 41, which is subjected to the same pressure as 5, remains closed, since it is regulated to open under the pressure action starting from a pressure equal to that which closes the valve 40. The valve 40 is closed when the pressure in the envelope reaches the maximum value Pm provided for 5. At the end of inflation, the overpressure generating means 37 supplies the air at a pressure higher than Pm. The valve 40 closes, the valve 41 opens and the air flows from 39 to 41 towards the atmosphere. The overpressure generating means may then be maintained in operation during the entire duration of utilisation of the floating craft, thus affording the advantage that in the event of accidental leakage of the envelope 5, the overpressure generating means is able to continuously re-inflate it. In fact, a considerable leakage in the envelope results in a pressure drop which once again opens the valve 40, the opening of which results in turn in a pressure drop at the inlet of the respiration valve 41, which closes, and the overpressure generating means once again feeds into the envelope. The envelope may be maintained under pressure, even when the overpressure generating means does not function, since the closed valve 40 prevents, in the absence of accidental leakage, the envelope from deflating.

The operation involving deflation of and establishment of a vacuum in the envelope is effected by causing the overpressure generating means to aspire in the envelope, the aspired air then being ejected into the atmosphere. For this purpose, the three-way valve 38 is manually rotated in such manner that the overpressure generating means 37 aspires no longer from the atmosphere but from the conduit 42 which is connected to the valve 40, which is opened by appropriate control means. The three-way valve 39 is manually oriented simultaneously with 38, in order that the air supplied through 37 shall be discharged to the atmosphere and not towards 40, as during the inflation operation; the respiration valve 41 is closed during deflation. On termination of deflation, when the vacuum in 5 has attained the fixed value, the respiration valve 41 is automatically opened under the effect of the negative pressure obtaining between 37 and 40, in such manner that the overpressure generating means is able to continue to function without deterioration, aspiration depression not exceeding the fixed value, and the envelope 5 remains evacuated, the valve 40 being open. In order to maintain the vacuum in 5 when the overgenerating means is at a standstill, the valve 40 is closed and the envelope is isolated from atmospheric pressure.

Figure 19 illustrates an example of a piloted valve. The piston 35 may be raised from the body 36 of the valve, either by the inflation pressure of the float, arriving on the left-hand side of the drawing, or by an auxiliary pressure arriving at the upper part of the drawing, in the body 36.

The invention is in no way limited to the embodiments described hereinabove by way of non-limitative examples; on the contrary, it covers all equivalent modifications which could be effected by the person skilled in the art; in particular, it should be noted that all the end securing means described could be utilised as articulation securing means.

WHAT WE CLAIM IS:—

1. An inflatable device in or for a body of the type specified, said body having a wall adjacent which the device is locatable, and said device comprising:

an inflatable and deflatable float positionable adjacent said wall;

a flap pivotally mountable relative to said wall for movement between open and closed positions relative to the wall, and co-operable with said float, said flap when in the closed position serving to maintain the float against the wall when the float is deflated;

means for inflating and deflating said float;

and means for pivoting the flap between the open and closed positions independently of movement of the flap consequent upon inflation and deflation of the float;

in which the float is defined at least partly by at least one member made of flexible material, and securable to said wall and to said flap by securing means locatable in the vicinity of the edges of the wall and of the flap.

2. A device according to Claim 1, in which said securing means for the flexible member are constituted by flexible tongues secured at one of their ends with the flexible member and securable at the other of their ends with said wall or one face of the flap.

3. A device according to Claim 2, in which the flexible tongues are sewn and adhesively secured to said flexible member.

4. A device according to Claim 2, in which the flexible tongues are secured to said flexible member by means of screws and nuts, fluid-tightness being maintained with the aid of sealing washers.

5. A device according to any one of Claims 1 to 4, in which said float is constituted on the one hand by rigid surfaces partially constituting the face of the flap and said wall and, on the other hand by at least one flexible articulation member and at least one flexible end member made from a fluid-tight flexible fabric and secured over their entire periphery in fluid-tight manner on the said rigid surfaces.

6. A device according to Claim 2 or 5, in which said other end of the flexible tongues and the said fluid-tight flexible articulation and end members is secured to the outer wall and to the face of the flap with the said of rigid attach members which compress the flexible material against the rigid surfaces of the flap and of the wall.

7. A device according to any one of Claims 2 to 4, in which said other end of the flexible tongues is secured to the said wall or to said flap face through the intermediary of rings, shackles or chain links extending simultaneously into the tongue and into at least one pivot fast with the flap or with a hull of said body.

8. A device according to Claim 6 or 7, in which said other end of the flexible tongues and said fluid-tight flexible members comprise a bead constituted by a rope gripped in a loop of said tongue or of the flexible material.

9. A device according to any one of Claims 2 to 4, in which said other end of the flexible tongues comprises a bead constituted by a rope engaged in a loop of the said tongue, the said bead being imprisoned in a rigid longitudinal member fixed parallel to a hull of said body or to the flap and in which the bead is able to slide when being placed in position.

10. A device according to Claim 1, in which said means for inflating and deflating the float are one and the same device comprising at least one air compressor associated with a circuit comprising two valves of the three-way type, a pilot valve and a respiration valve; the air being aspired during the inflation operation through a first three-way valve, pressurised by the compressor, and fed through a second three-way valve towards the pilot valve which permits the air to enter the float; the compressor, at the end of the inflation operation, supplying air at a pressure higher than the inflation pressure provided for the float, the pilot valve closes the respiration valve opens, and the air flows, from the second three-way valve into the atmosphere via the respiration valve, the pressure being adapted to be maintained in the float by closing the pilot valve or by allowing the compressor to continue to operate, the latter then automatically compensating for any pressure losses; the operation for deflation and putting under vacuum of the float being effected by causing the compressor to aspire in the float, the first three-way valve then being disposed in such manner as to communicate simultaneously, with the compressor and a conduit connected to the pilot valve which is opened by appropriate control means, the second three-way valve being orientated simultaneously with the first three-way valve in such manner that the air supplied by the compressor is discharged to the atmosphere, the respiration valve being closed during deflation and opening automatically at the end of deflation when the vacuum in the float has attained the fixed value, under the effect of the negative pressure between the compressor and the pilot valve, the vacuum being adapted to be maintained in the float by closing the pilot valve or by leaving the compressor in operation, the latter then automatically compensating for a pressure increase in the float.

11. A device according to any one of the preceding claims, in which said means for pivoting the flap comprises at least one linear jack disposed in the flap or in said

body and exerting a torque on the flap through intermediary of a lever arm.

12. A device according to any one of Claims 1 to 10, in which said means for pivoting the flap comprises at least one rotary jack coaxial with the pivoting axis of the flap relative to said wall.

13. A device according to Claim 1 or 11, in which said means for pivoting the flap comprise:

a linear jack fast with said body and located in the vicinity of said wall;

a lever pivoting about a pivot substantially parallel to said wall, a first end thereof being subjected to the action of the linear jack and the second end having an oblong, curvilinear port whereof the equidistant walls are arcs of a circle having a common centre;

and means for driving the flap in rotation, having a pivot or axis substantially parallel to said wall, displaced in the said port, and fast with the flap in the vicinity of the rotation axis of the flap relative to the wall.

14. A device according to Claim 13, in which said linear jack is disposed in a hull of said body.

15. A device according to Claim 13 or 14, in which the means driving the flap in rotation is a runner or skid oscillating about a pivot substantially parallel to the axis of rotation of the flap relative to the hull.

16. A device according to any one of Claims 13 to 15, in which the distance between the rotation axis of the flap and the pivoting axis of the lever is smaller than the sum of the distances between on the one hand the rotation axis of the flap and the axis of the means driving the flap in rotation and, on the other hand, the pivoting axis of the lever and the common centre of the arcs of a circle constituting the equidistant walls of the port.

17. A device according to any of Claims 13 to 16, in which the difference squared between on the one hand the distance separating the rotation axis of the flap and the pivoting axis of the lever and on the other hand the distance separating the pvioting axis of the lever and the common centre of the arcs of the circle constituting the equidistant walls of the port, increased by the square of the distance separating the said common centre and the pivot of the means driving the flap in rotation, is substantially equal to the square of the distance between the rotation axis of the flap and the pivot of the means driving the latter in rotation.

18. An inflatable device according to Claim 1 and substantially as hereinbefore described with reference to, and as shown in the accompanying drawings.

19. A body of the type specified having a device according to any one of the preceding claims.

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Printed for Her Majesty's Stationery Office, by the Courier Press, Leamington Spa, 1978
Published by The Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

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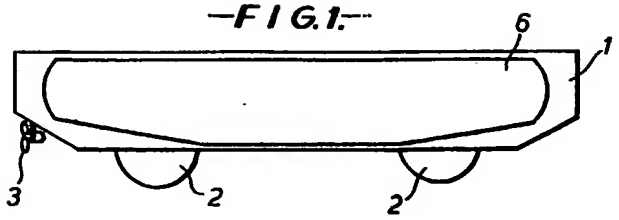
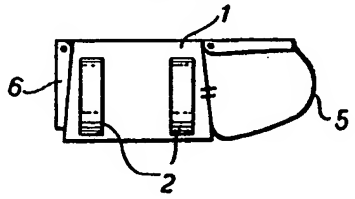
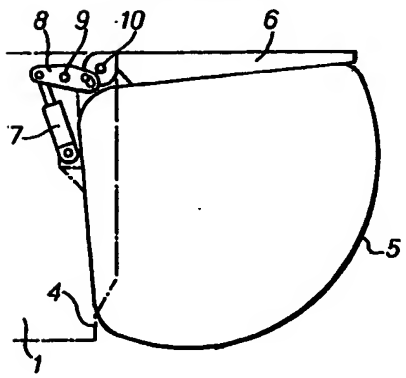
—FIG.1.—



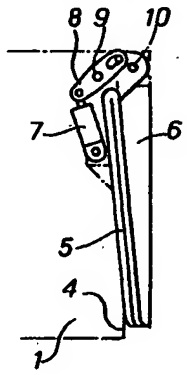
—FIG.2.—



—FIG.3.—



—FIG.7.—



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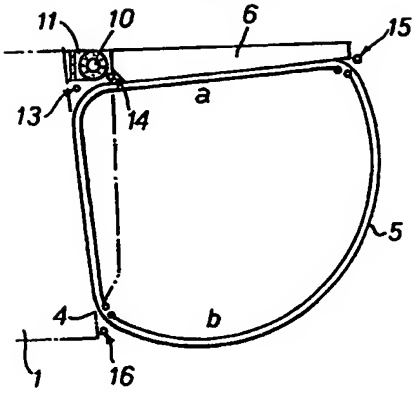
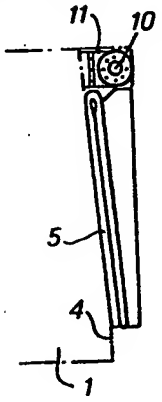
—FIG. 4.—



—FIG. 8.—



—FIG 11.—

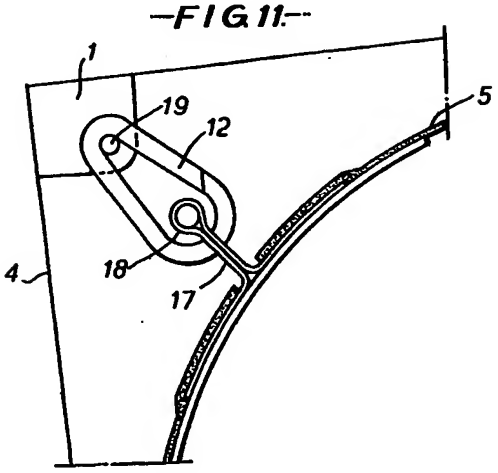


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FIG.5.

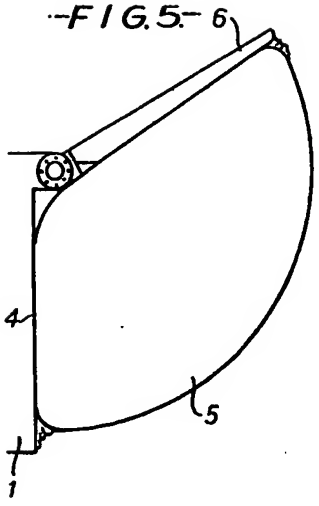


FIG.6.

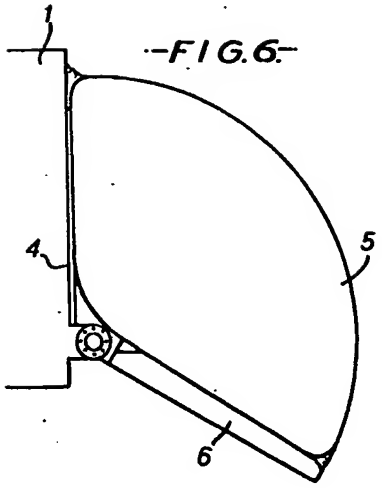


FIG.9.

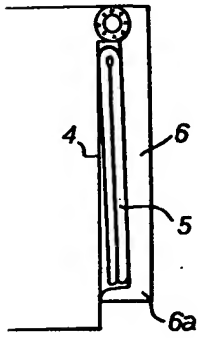
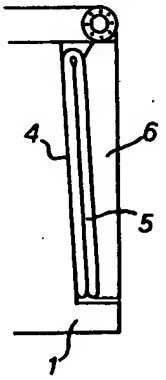
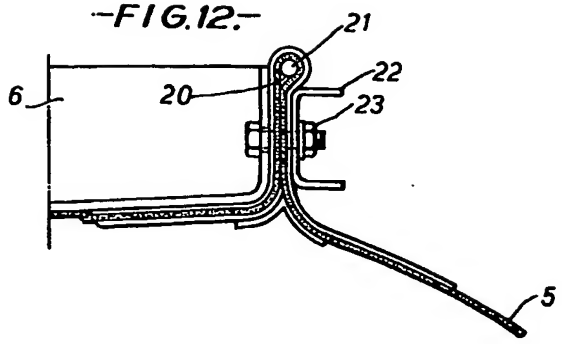


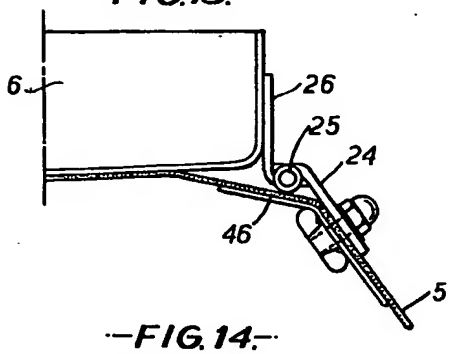
FIG.10.



-FIG.12.-



-FIG.13.-



-FIG.14.-

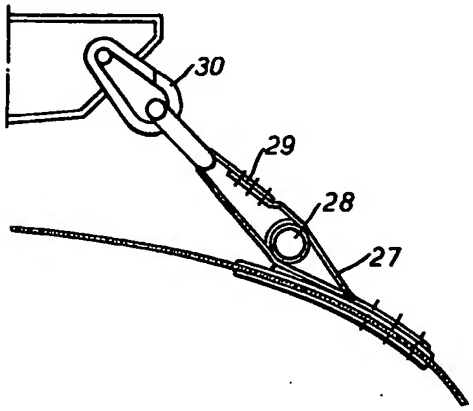


FIG. 15

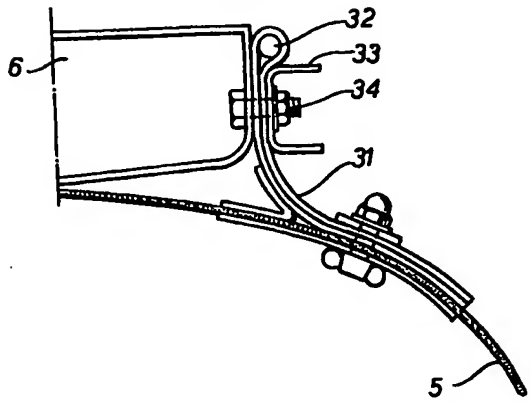
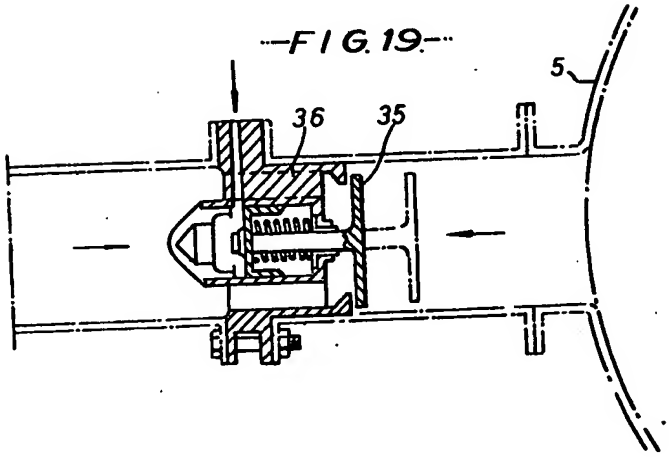
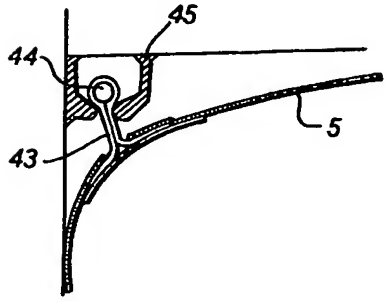


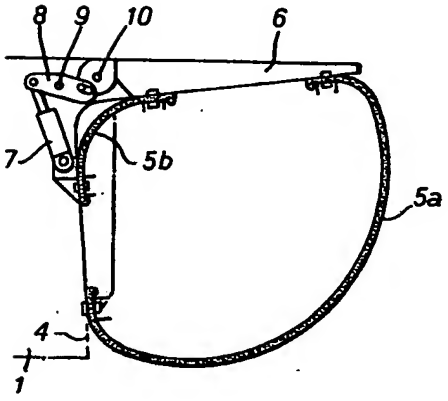
FIG. 19



—FIG. 16.—



—FIG. 17.—



1505511 COMPLETE SPECIFICATION
8 SHEETS This drawing is a reproduction of the Original on a reduced scale
Sheet 7

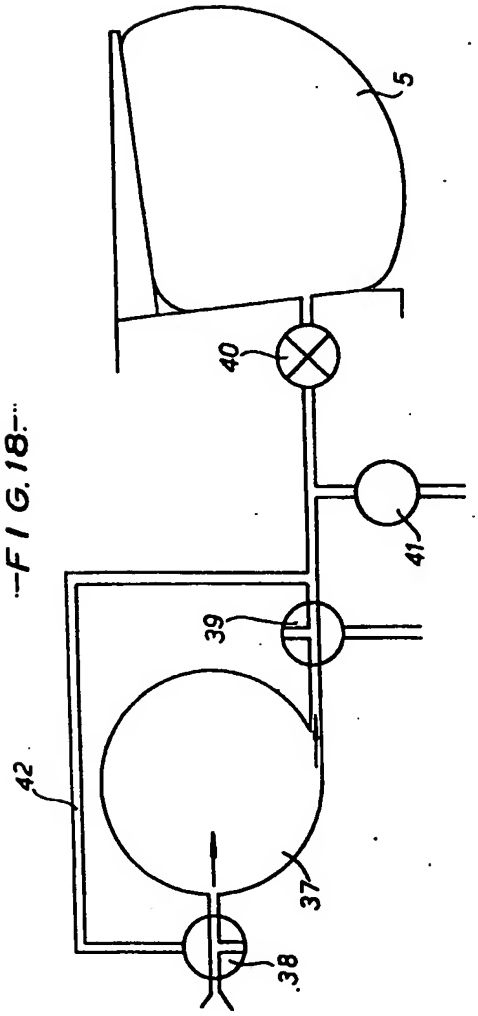
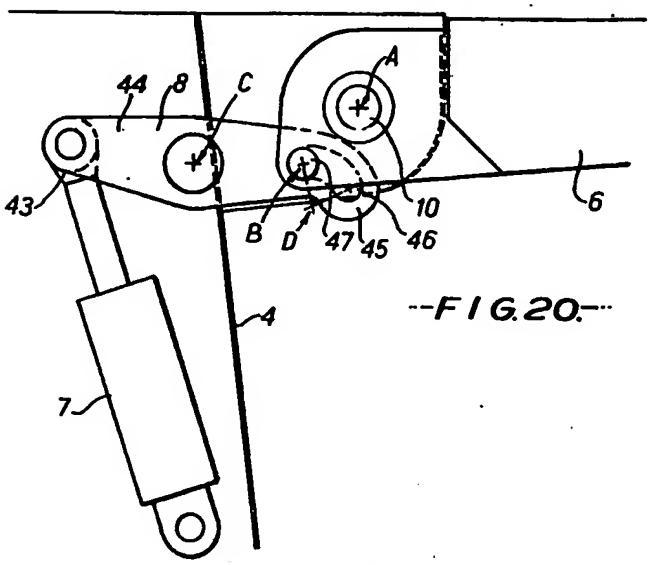
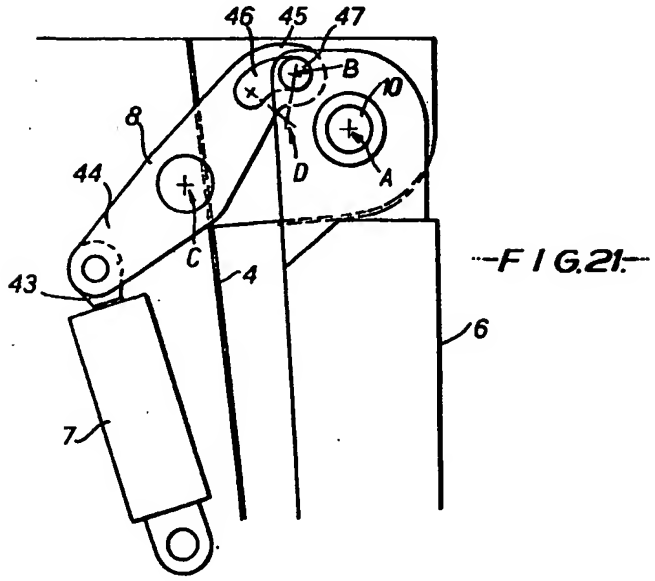


FIG. 18.

1505511 COMPLETE SPECIFICATION
8 SHEETS This drawing is a reproduction of the Original on a reduced scale
Sheet 8



--FIG.20.--



--FIG.21.--